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17

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10/776,591	02/12/2004	Kazuya Fukuhara	03180.0353	3478

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FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER LLP
901 NEW YORK AVENUE, NW
WASHINGTON, DC 20001-4413

EXAMINER	
THOMAS, MIA M	

ART UNIT	PAPER NUMBER
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/776,591	FUKUHARA, KAZUYA	
	Examiner	Art Unit	
	Mia M. Thomas	2624	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *12 February 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *see attached*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Priority

1. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

Claim Suggestions

2. Examiner makes the following claim suggestions and requests that these suggestions be considered:

At page 34, line 20, claim 2, the interpretation of the claim is somewhat vague. Examiner suggests that the claim be re-written, especially to clarify the lines that discuss the brightness and elements thereafter. For example,

- Claim 2: The inspection method of Claim 1, wherein the reference image data and the inspection image data are at least one of ~~a~~ brightness measurements or indications of the inspection image, of the inspection pattern ~~,~~ and a shape of the inspection pattern.

Accordingly for claims 3, 9, 10, 16 and 17, the same claim suggestions should be considered for each claim.

Claim Objections - 37 CFR 1.75(a)

3. The following is a quotation of 37 CFR 1.75(a):

> The specification must conclude with a claim particularly pointing out and distinctly claiming the subject matter that the applicant regards as his invention or discovery.

4. Claim 12 is objected to under 37 CFR 1.75(a) as failing to particularly point out and distinctly claim the subject matter which the applicant regards as his invention or discovery.

Regarding claim 12, the term "the processor" at page 37, line 3 lacks an antecedent basis. However, it appears from the context of the claim when read in light of the specification that "the processor" is in fact referring to the "processor" first introduced at page 35, line 23 of claim 8; and this will be assumed for examination purposes.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

6. Claims 15-20 are rejected under 35 U.S.C. 102(b) as being anticipated by Hiroi (6,172,365 B1).

Regarding Claim 15: Hiroi discloses a method for manufacturing a semiconductor device ("The present invention relates to a method ... for

obtaining an image or a waveform representing a physical property of an object such as a semiconductor wafer with an electron beam..." at column 1, line 15) comprising:

executing an inspection processing of an exposure tool ("...an object of the present invention is to provide an electron beam inspection method, and apparatus..." at column 1, line 52) including:

coating a surface of an inspection target substrate with an inspection resist film ("A semiconductor is fabricated on a semiconductor substrate (wafer) via a film..." at column 33, line 29);

placing a plurality of imaging components deviating from an optical conjugate plane of a surface of the inspection resist film (Refer to Figure 6a-6e; "The same holds true also for other objects such as a photo-mask, thin film multilayer substrate, printed circuit board or TFT substrate." at column 11, line 36);

generating a plurality of inspection patterns of the inspection resist film having a plurality of openings, by projecting exposure beams output from a plurality of effective light sources onto the inspection resist film via the imaging components ("By using an electron beam according to the present invention, a pattern on an object such as a semiconductor wafer is detected." at column 11, line 40);

measuring one of the inspection patterns as a reference image, and processing the reference image so as to provide reference image data (Refer to Figure 4a);

and determining an abnormal inspection image by measuring inspection

images of the inspection patterns (Refer to Figure 4b) and comparing a plurality of inspection image data provided by processing the inspection images with the reference image data (Refer to Figures 4b and 4c, also Figure 23, numeral 53); correcting the exposure tool by acquiring a type of defect from the abnormal inspection image when the abnormal inspection image is determined to occur (Refer Figure 13, numeral 27);

coating a semiconductor substrate with a manufacturing resist film ("A semiconductor is fabricated on a semiconductor substrate (wafer) via a film..." at column 33, line 29);

loading a manufacturing photo mask and the semiconductor substrate to the exposure tool, and subjecting the semiconductor substrate to a manufacturing process of a semiconductor device by delineating the manufacturing resist film using the manufacturing photo mask (Refer to Figure 18).

Regarding Claim 16: Hiroi discloses the method of claim 15, wherein the reference image data and the inspection image data are at least one of a brightness of the inspection image of the inspection pattern and a shape of the inspection pattern ("From the strength (brightness) of a digital image signal correlative to the yielded secondary electrons detected by the sensor 11 in a place coinciding with the outside shape of a pattern (material A or B)..." at column 21, line 52).

Regarding Claim 17: Hiroi discloses the method of claim 15, wherein the abnormal inspection image being due to a defect including at least one of dust, a scratch in an illumination optical system which forms the effective light source, and an aberration of the illumination optical system (Refer to Figure 4a, numeral 7).

Regarding Claim 18: Hiroi discloses the method of claim 15, wherein the imaging components are a plurality of pinholes provided in an opaque film ("A semiconductor is fabricated on a semiconductor substrate (wafer) via a film forming dry process for forming an insulator film such as an interlayer insulator film or a guard film and a wiring metal film, an etching dry process for forming an insulator film pattern having a circuit pattern and through-holes..." at column 33, line 29).

Regarding Claim 19: Hiroi discloses the method of claim 15, wherein the imaging components are a plurality of lenses in a lens array (Refer to Figure 13).

Regarding Claim 20: Hiroi discloses the method of claim 18, wherein the pinholes implement diffraction grating having a translucent film and a transparent portion arranged in a grid pattern (Refer to Figure 16, numeral 48 and 49; "...a potential providing device 19 such as a grid disposed between the

objective lens 18 and the wafer (object) 20, a wafer holder 21 for holding the wafer 20 mounted thereon..." at column 24, line 67).

7. Claims 8-14 are rejected under 35 U.S.C. 102(b) as being anticipated by Yamada et al (US 6,222,195 B1).

Regarding Claim 8: Yamada discloses a processor for inspecting an illumination optical system of an exposure tool (Refer to Figure 1), comprising: a data input module (Refer to Figure 1, numeral 153; "The control unit 150 includes memory media 151 comprising a disk or MT recorder for storing design data of integrated circuits, and a CPU 152 controlling the electron-beam exposure device. The control unit 150 further includes a data-management unit 153..." at column 2, line 5) configured to acquire a reference image and inspection images of a plurality of inspection patterns of a resist film having a plurality of openings, the inspection patterns obtained by projecting exposure beams output from a plurality of effective light sources onto the resist film coated on a surface of an exposure target substrate by a plurality of imaging components, the imaging components placed so as to deviate from an optical conjugate plane of the surface of the resist film;

an image processing module configured to calculate reference image data and inspection image data from the reference image and the inspection images, respectively (Refer to Figure 4);

and a determination module configured to compare the inspection image data with the reference image data, so as to determine whether the inspection image data is abnormal (Refer to Figure 4, numeral S4-S7).

Regarding Claim 9: Yamada discloses the processor of claim 8, wherein the reference image data and the inspection image data are at least one of a brightness of the inspection image of the inspection pattern and a shape of the inspection pattern ("The exposure-column unit 110 further includes a first slit 115 shaping the electron beam rectangular, a first lens 116 converging the shaped beam, and a slit deflector 117 deflecting a position of the shaped beam on a block mask 120 based on a deflection signal S1." at column 1, line 45).

Regarding Claim 10: Yamada discloses the processor of claim 8, wherein the abnormal inspection image being due to a defect including at least one of dust, a scratch in an illumination optical system ("A difference between the two waveforms indicates that either one of the mask patterns 13A or 13B has a defect. In this case, it is possible to rely on a visual inspection to determine which one of the mask patterns 13A and 13B has the defect." at column 12, line 23) which forms the effective light source, and an aberration of the illumination optical system ("A subsequent inspection after the replacement of one of the masks will be repeated until no difference is detected between the two signal waveforms." at column 12, line 30).

Regarding Claim 11: Yamada discloses the processor of claim 8, wherein the imaging components are a plurality of pinholes provided in an opaque film (Refer to Figures 10a and 10b; "For the pattern inspection of this embodiment, a glass board coated with a thin metal layer (e.g., Cr wafer) is preferably used, and a pattern is transferred onto the metal layer by etching. This is because a sharper pattern than a resist pattern can be formed on the metal layer on the glass board to achieve more reliable inspection by using the comparison-inspection device." at column 16, line 59).

Regarding Claim 12: Yamada discloses the processor of claim 8, wherein the imaging components are a plurality of lenses in a lens array ("...a first lens 116, The exposure-column unit 110 further includes second and third lenses 118 and 119 opposing each other..." at column 1, line 52).

Regarding Claim 13: Yamada discloses the processor of claim 11, wherein the pinholes configure a diffraction grating having a translucent film and a transparent portion arranged in a grid pattern (Refer to Figure 6, S11-S19, specifically, numeral S13).

Regarding Claim 14: Yamada discloses the processor of claim 13, wherein the reference image data and the inspection image data further include a variation

of a center position between at least one of the inspection patterns formed by a zeroth-order diffraction beam of the diffraction grating and an outer edge formed by a plurality of first-order diffraction beams, and a size of the outer edge (Refer to Figure 6, numeral S16).

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

9. Claims 1-7 are rejected under 35 U.S.C. 103(a) as being obvious over Sato et al. (2001/0019407 A1), hereinafter referred to as Sato '407 in combination with Hiroi (6,172,365 B1).

The applied reference has a common assignee with the instant application. Based upon the earlier effective U.S. filing date of the reference, it constitutes prior art only under 35 U.S.C. 102(e). This rejection under 35 U.S.C. 103(a) might be overcome by: (1) a showing under 37 CFR 1.132 that any invention disclosed but not claimed in the reference was derived from the inventor of this application and is thus not an invention "by another"; (2) a showing of a date of invention for the claimed subject matter of the application which corresponds to subject matter disclosed but not claimed in the reference, prior to the effective U.S. filing date of the reference under 37 CFR 1.131; or (3)

an oath or declaration under 37 CFR 1.130 stating that the application and reference are currently owned by the same party and that the inventor named in the application is the prior inventor under 35 U.S.C. 104, together with a terminal disclaimer in accordance with 37 CFR 1.321(c). This rejection might also be overcome by showing that the reference is disqualified under 35 U.S.C. 103(c) as prior art in a rejection under 35 U.S.C. 103(a). See MPEP § 706.02(l)(1) and § 706.02(l)(2).

Regarding Claim 1: Sato '407 discloses an inspection method for an illumination optical system (Refer to Figure 2) of an exposure tool comprising:
coating a surface of an exposure target substrate with a resist film ("...a plurality of resist patterns are transferred onto the wafer." at [0026]; "Further, in general cases, the circuit pattern of the photo-mask is focused and projected on a substrate applied with a photosensitive material, e.g., a silicon wafer applied with photo-resist." at [0005]);
placing a plurality of imaging components deviating from an optical conjugate plane of a surface of the resist film (Refer to Figure 2, numeral 7a and 7b, "The present invention provides a method for inspecting an exposure apparatus, comprising: a step of guiding light emitted from an illumination optical system to a photo-mask..." at [0019]),
generating a plurality of inspection patterns of the resist film having a plurality of openings ("FIGS. 15A and 15B are views showing shapes of photo-resist

patterns formed by an inspection method according to the embodiment, compared with another embodiment..." at [0046]), by projecting exposure beams output from a plurality of effective light sources onto the resist film via the imaging components ("An illumination optical system can be constructed by an aggregation of a plurality of point light sources, as specifically shown in FIGS. 6E to 6H." at [0075]);

measuring one of the inspection patterns as a reference image, and processing the reference image so as to provide reference image data ("Of course, at least one of the photo-mask and the wafer may be shifted from a conjugate position in the light axis direction." at [0028]; "FIG. 4 is a plan view showing photo-resist patterns obtained by pattern exposure according to the embodiment", where numeral 32 serves at the reference image." at [0035]);

and determining an abnormal inspection image by measuring inspection images of the inspection patterns and comparing a plurality of inspection image data provided by processing the inspection images with the reference image data ("If a pattern is transferred with use of the patterns 51a to 51d having four kinds of duty ratios and one same period, the shapes of the respective photo-resist patterns become different from each other, as shown in FIGS. 6E to 6H." at [0075]).

Regarding Claim 2:

Sato '407 discloses an inspection method for an illumination optical system (Refer to Figure 2) of an exposure tool comprising: measuring one of the inspection patterns as a reference image, and processing the reference image so as to provide reference image data at [0035]).

Sato '407 does not expressly disclose that the reference image data and the inspection image data are at least one of a brightness of the inspection image of the inspection pattern and a shape of the inspection pattern.

Hiroi in the same field of manufacturing inspection teaches the inspection method of claim 1, wherein the reference image data and the inspection image data are at least one of a brightness of the inspection image of the inspection pattern and a shape of the inspection pattern ("From the strength (brightness) of a digital image signal correlative to the yielded secondary electrons detected by the sensor 11 in a place coinciding with the outside shape of a pattern (material A or B)..." at column 21, line 52).

At the time the invention was made, it would have been obvious to one of ordinary skill in the art to modify the inspection of the image data as disclosed by Sato '407 to incorporate the inspection data to include at least an inspection method based on brightness of each inspection pattern as taught by Hiroi because the brightness of the pattern would help the user to identify which if any defects in the pattern exist.

Regarding Claim 3:

Sato '407 discloses an inspection method for an illumination optical system (Refer to Figure 2) of an exposure tool comprising: [the ability to] determine an abnormal inspection image by measuring inspection images of the inspection patterns and comparing a plurality of inspection image data provided by processing the inspection images with the reference image data.
Sato '407 does not expressly disclose that the abnormal inspection image occurs due to a defect including at least one of dust, a scratch in an illumination optical system that forms the effective light source, and an aberration of the illumination optical system.
Hiroi teaches the inspection method of claim 1, wherein the abnormal inspection image occurs due to a defect including at least one of dust, a scratch in an illumination optical system which forms the effective light source, and an aberration of the illumination optical system (Refer to Figure 4a, numeral 7).

At the time the invention was made, it would have been obvious to one of ordinary skill in the art to modify the abnormal inspection method as disclosed by Sato to include an inspection method which forms the effective light source and aberration of the optical system as taught by Hiroi because the abnormal inspection method would allow the user to identify the immediate changes in the pattern based on the reference image data and the defective image data.

Regarding Claim 4:

Sato '407 discloses an inspection method for an illumination optical system (Refer to Figure 2) of an exposure tool comprising: placing a plurality of imaging components deviating from an optical conjugate plane of a surface of the resist film.

Sato '407 does not expressly disclose that the imaging components are a plurality of pinholes provided in an opaque film.

Hiroi teaches the inspection method wherein the imaging components are a plurality of pinholes provided in an opaque film ("A semiconductor is fabricated on a semiconductor substrate (wafer) via a film forming dry process for forming an insulator film such as an interlayer insulator film or a guard film and a wiring metal film, an etching dry process for forming an insulator film pattern having a circuit pattern and through-holes..." at column 33, line 29).

At the time the invention was made, it would have been obvious to one of ordinary skill in the art to utilize a plurality of pinholes provided in an opaque film as taught by Hiroi to the imaging components as disclosed by Sato because the pinholes on opaque film are most commonly used as industry standard and would provide the most useful option for imaging components.

Regarding Claim 5:

Sato '407 discloses an inspection method for an illumination optical system (Refer to Figure 2) of an exposure tool comprising: placing a plurality of imaging

components deviating from an optical conjugate plane of a surface of the resist film.

Sato '407 does not expressly disclose that the imaging components are a plurality of lenses in a lens array.

Hiroi teaches the inspection method of claim 1, wherein the imaging components are a plurality of lenses in a lens array (Refer to Figure 13).

At the time the invention was made, it would have been obvious to modify the imaging components to include a plurality of lens in a lens array as taught by Hiroi to method of inspection as disclosed by Sato because the lenses in the lens array would amplify the illumination of the wafer and mask to allow the user to most suitably measure the image data of the optical system.

Regarding Claim 6:

Sato '407 discloses an inspection method for an illumination optical system (Refer to Figure 2) of an exposure tool comprising: placing a plurality of imaging components deviating from an optical conjugate plane of a surface of the resist film.

Sato '407 does not expressly disclose that the pinholes implement a diffraction grating having a translucent film and a transparent portion arranged in a grid pattern

Hiroi teaches the inspection method of claim 4, wherein the pinholes implement a diffraction grating having a translucent film and a transparent

portion arranged in a grid pattern (Refer to Figure 16, numeral 48 and 49; "...a potential providing device 19 such as a grid disposed between the objective lens 18 and the wafer (object) 20, a wafer holder 21 for holding the wafer 20 mounted thereon..." at column 24, line 67).

Regarding Claim 7: Sato '407 discloses the inspection method of claim 6, wherein the reference image data and the inspection image data further include a variation of a center position between at least one of the inspection patterns formed by a zeroth-order diffraction beam ("As shown in FIG. 2, zeroth-order diffraction light 6, ...accordingly, a zeroth-order diffraction pattern 32 and positive and negative first-order diffraction light patterns 33a and 33b are created on the wafer 5." at [0062]) of the diffraction grating and an outer edge formed by a plurality of first-order diffraction beams, and a size of the outer edge (Refer to Figure 6a-6h).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Mia M. Thomas whose telephone number is 571-270-1583. The examiner can normally be reached on Monday-Friday 8:30am-5pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Brian Werner can be reached on 571-272-7401. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Mia M Thomas
Examiner
Art Unit 2624

MMT

/Brian P. Werner/
Supervisory Patent Examiner (SPE), Art Unit 2624